Technology Support and Transfer from ORD's National Risk Management Research Laboratory to EPA Regions

Technology Transfer Examples

Environmental Technology Verification (ETV) Support

September 27, 2007

Title: New Scientific Methods for Assessing Area Source Emissions
Region: Region 1
Problem statement: The State of New Hampshire, local officials and Region 1 were searching for a methodology that would assess emissions from reclaimed landfills.
Background statement: A playground in New Hampshire was created by capping a landfill. The parents of the school children using the playground, the state and the Region became concerned about the integrity of the cap applied and the possibility of harmful emissions affecting the school children using the playground. Assistance from EPA/ORD through the RARE process was requested.
Positive outcomes: As a result of applying our optical remote sensing and scanning technology, we were able to map emissions over the entire surface of the playground. The cap on the landfill was shown to be effective in containing the emissions with one very important exception. A hole had been dug to install a light pole, but the pole had not been installed. High levels of ammonia and methane emissions were shown to be coming from this penetration of the cap on the landfill. This penetration was sealed and the playground was made safe for use.
Regional and ORD Staff Involved: Richard Shores, Edgar Thompson, Susan Thorneloe and Bruce Harris (ORD, NRMRL, APPCD) were on site conducting these assessments.
What made the technology transfer successful: APPCD has for several years been developing a scanning technique to measure the pollutant concentration in various parts of the plume and determine the emissions flux. Without this newly developed technique, this landfill and many other area sources could not be quantitatively assessed.

Title: Air quality and climate change decision-making technology
Region: 1
Problem Statement: The states in Region 1 were searching for a comprehensive approach on ways to improve air quality through technology decisions that would allow the states to work together for the benefit of the whole. Decisions that they were contemplating would have the potential to affect air quality for decades into the future.
Background: By updating DOE's MARKAL model and populating it with appropriate data in critical areas, ORD is providing decision makers with a tool to see interactions of different pathways. Decision makers can quickly see the potential future consequences of various assumptions for different scenarios of today's decisions. Region 1 and NESCAUM were provided with the tool, training on how to use it, and a methodology to populate the tool with data relevant to their states.
Positive Outcomes: NESCAUM is now able to see the consequences of contemplated decisions on the whole region. This process and tool are being used to help make more informed decisions and thus improve air quality and climate change.
Region and ORD Staff Involved: John King, Bill White, Dave Conroy, and Lucy Edmondsen (Region 1); Elizabeth Wilson and Evelyn Wright (former EPA); Carol Shay, Cynthia Gage, and Dan Loughlin (ORD)
What Made the Technology Transfer Successful: With ORD's assistance and training, the Region and NESCAUM were able to use the tool and understand the implications of their assumptions.

Title: Demonstration Technologies to Cost-Effectively Remove Arsenic from Drinking Water
Region: 1, 2, 3, 5, 6, 8, 9, 10 (see attached table for specifics)
Problem Statement: Long-term chronic exposure to arsenic can lead to cancer and non-cancer debilitating health effects. Arsenic enters drinking water supplies from natural deposits in the earth or from agricultural and industrial practices.
Background: EPA has set the arsenic standard for drinking water at .010 parts per million (10 parts per billion) to protect consumers served by public water systems from the effects of long-term, chronic exposure to arsenic. To help water drinking water utilities choose the most cost-effective systems to meet water quality requirements, EPA has sponsored a demonstration program where commercially-ready technologies and engineered solutions are tested under local conditions at 50 sites in 26 states.
Positive Outcome(s): Demonstrated systems have met the MCLs without exacerbating other drinking water considerations (e.g., lead/copper solubility); general water quality has improved in tested systems. Local utilities are beginning to purchase and install successfully demonstrated technologies in other parts of their respective watersheds.
Regional and ORD Staff Involved: Tom Poeton, early involvement (R6), Tom Sorg and Darren Lytle, NRMRL.
What Made the Technology Transfer Successful: Four national workshops, 25 EPA demonstration reports, 2 journal articles, an arsenic research website (http://www.epa.gov/ORD/NRMRL/wswrd/dw/arsenic/) and numerous presentations have shown the success of various treatment technologies in specific water quality parameters.

Arsenic Demonstration Projects
50 projects – 26 States

States	No. of Sites	States	No. of Sites
ME	3	ND	1
NH	3	SD	1
VT	1	LA	1
CT	2	TX	3
NY	1	NM	3
DE	1	AZ	3
MD	1	UT	1
PA	1	ID	2
OH	2	NV	1
MI	3	MT	1
WI	2	WA	1
IL	2	OR	2
MN	4	CA	3

Title: Technologies to Study and Prevent Lead and Copper Entry into Drinking Water
Regions: 1, 2, 3, 4, 5, 8, 9, 10
Problem Statement: Drinking water system infrastructure and individual plumbing practices have led to the potential release of metals such as lead and copper into drinking water. Health impacts due to lead and copper exposures have been documented. Corrosion leads to the release of copper and lead ions and the deposit of corrosion by products on pipe walls. The solubility of these by-products ultimately determines the level of such metals in the water at our taps.
Background: Distribution system materials, plumbing age and disinfection/storage practices are being studied to better understand the interaction of materials and water chemistry and the consequences of specific drinking water distribution choices on the quality of consumed water.
Positive Outcome: Improved understanding of the effects of water chemistry on the various distribution system components has aided individual suppliers in best practices to limit health consequences. Communities serviced indicated in attached table.
Regional and ORD Staff Involved: Ellie Kwong, Jane Downing, Kevin Reilly, Ronnie Levin (R1), Bruce Kesilica, Justine Jaccoma (R2), Lisa Donahue, Rick Rogers (R3), Tom Degaetano (R4), Miguel DelToral, Charlene Denys (R5), Bob Clement, Breanne Bockstahler (R8), Bruce Macler, Barry Pollock (R9), Wendy Marshall (R10), ORD-NRMRL, Darren Lytle and Michael Schock.
What Made the Technology Transfer Successful: 2007 national inorganic contaminants workshop, corrosion research websites (http://www.epa.gov/nrmrl/wswrd/cr/corr_res_lead.html), seven published journal articles (six more at press), 35+ presentations and numerous visiting student theses products have spread the research findings and availability of best practices and technical support.

Copper or Lead Corrosion Concerns (46)			**Iron Corrosion Concerns (4)**	
Wahington, DC	Dartmouth, MA		Cincinnati, OH	Stow, OH
Lansing, MI	EBMUD, CA		Reynoldsburg, OH	Waynesville, IL
Indianapolis, IN	New Bedford, MA			
Greenville, SC	New Britain, CT			
Raleigh-Durham, NC	Madison, WI			
Maui, HI	New Haven, CT			
Fall River, MA	New York City, NY			
Springfield, MA	Portland, ME		**Arsenic Removal Concerns (11)**	
Newport, RI	Reading, MA		Arnaudville, LA	Hammond, IL
Lakehurst Acres, ME	Rochester, NY		Beaver Creek, OH	Leroy, IL
Providence, RI	Salem-Beverly, NY		Coachella Valley, CA	Licking Valley, OH
Portsmouth, RI	Salem, NH		Danvers, IL	McLean, IL
Ottawa, Canada	San Francisco, CA		Fountain City, IN	Waynesville, IL
Montreal, Canada	Butler County, OH		Fountain Valley, IL	
New York, NY	Cincinnati, OH			
Birmingham, AL	Manatee, FL			
Champlain, IL	Portland, ME			
Carlsbad, CA	Sarasota, FL			
Camp Pendelton	WPAFB, OH			
Ontario, Canada	Norfolk, MA		**Nitrification Concerns (5)**	
Normal, IL	McEwen, TN		Danvers, IL	Normal, IL
San Clemente, CA	Colrein, OH		Hammond, IL	McLean, IL
Bremen, IN	Aberdeen, ND		Leroy, IL	

Title: Emissions characterization from school bus operation
Region: 2
Problem Statement: Diesel exhaust is a likely human carcinogen and can also contribute to other acute and chronic health effects. Children are generally more susceptible to air pollutants such as diesel PM because their respiratory systems are still developing and they have a faster breathing rate. For these reasons, concern has been raised about the exposure of children to exhaust pollutants associated with diesel school buses during the commute to and from school, and during idling periods. Further, there has been interest over the volume of PM emissions of idling vs. shutdown and restart.
Background: ORD-NRMRL studied the PM and gaseous emissions associated with the loitering of diesel school buses during the loading/unloading of children at schools. This study was conducted in collaboration with EPA Region 2 and the Katonah-Lewisboro School District located in Cross River, NY.
Positive Outcomes: Validated current EPA policy under the Clean School Bus Initiative. Idle reduction can be used to effectively lower emissions and reduce student exposure to air pollutants from diesel engine exhaust.
Region and ORD Staff Involved: Reema Loutan, Raymond Werner (Region 2); Jim Miniham (School District); Trish Koman (OTAQ); John Kinsey (ORD)
What Made the Technology Transfer Successful: The results were disseminated using both technical journal article and a custom made Power Point presentation now available on the Region's website.

Title: Technical Support to Evaluate the Cost and Performance of Innovative Water Filtration Technologies Integrated to Remote Telemetry Systems in High-Turbidity Public Surface Water Systems in Tropical Environments
Region: Region 2, Caribbean
Problem Statement: Storm events and associated extreme turbidity swings in surface waters are relatively frequent in Tropical rural areas. High solids-loading in the treatment system overwhelms treatment capacity leading to high maintenance costs or equipment failure.
Background: Appropriate strategies for protecting water quality and treatment systems are needed to reduce waterborne diseases risks and improve compliance with the Surface Water Treatment Rule (SWTR). An integrated network approach was developed that includes: watershed management, innovative technologies, real-time remote source water monitoring through Remote Telemetry Systems (RTS), and water treatment monitoring and control through circuit riders assisted by RTS.
Positive Outcome(s): Results demonstrating the effectiveness of remote telemetry for monitoring and control of a drinking water treatment system in a rural, remote environment; and a filtration/chlorination system (22,000 gallons/day), featuring slow-sand filtration. This system serves the Rio Piedras community and continues to be developed as a test and evaluation facility and, hopefully, a future field training site for operators throughout the Caribbean.
Regional and ORD staff involved: Craig Patterson, James A. Goodrich, Roy Haught, Chris Impellitteri (ORD, NRMRL, WSWRD). Cristina Maldonado, Jaime Geliga, Jorge Martinez, Carl Axel-Soderberg, Marie O'Shea (R2)
What made the Technology Transfer Successful: Cooperation and communication between ORD, R2, the on-site contractor (Shaw Environmental, Inc.), and staff/students/faculty at the University of Puerto Rico-Mayaguez.

Title: Data Set Acquisition to Model Storm Water Runoff from Green Roofs
Region: Region 3
Problem Statement: Urban planners need flexible and cost-effective ways to control flow of and reduce the volume of stormwater.
Background: Green roofs (eco roofs) contain vegetated plantings about 4-6 inches deep applied over waterproofed roofs of concrete, wood or metal. Green roofs offer a practical alternative for new roof construction and for retrofitting existing roofs. They are designed to slow rainfall runoff primarily from larger storms; smaller storms often have no runoff from a green roof. The EPA-Penn State project investigates the effectiveness of green roofs in limiting stormwater volume discharge and reducing pollutant runoff content. The field tests include real-time continuous runoff, storage, and runoff quantity and quality .
Positive Outcome(s): Results indicate that green roofs effectively buffer acid rain. Runoff from rainfall events of less than 1-inch was entirely contained by green roofs. Research on design and performance will help municipalities and private entities make decisions associated with this technology and assist in integrating green roof use into an overall stormwater management plan.
Regional and ORD Staff Involved: Ron Landy, R3 ORD Regional Scientist, and Thomas P. O'Connor, ORD/NRMRL
What made the Technology Transfer Successful: Results widely shared via posters and conference papers; final report being completed; journal article submitted; three theses completed.

Title: Technology needed to monitor petroleum vapors associated with releases from underground storage tanks
Region: 3, 5 and 8
Problem Statement: Current monitoring techniques are based on the collection and analysis of gas samples. The analyses are expensive, and the samples represent only the instant in time when the samples were collected.
Background: ORD has developed an alternative to using vapor monitoring wells to monitor the intrusion of vapors of fuel components into buildings, which is a passive diffusion sampler that provides an integrated sample over several days. The sampler does not require the exchange of gases, and in theory, would be less subject to artifacts from extraction of large quantities of vapor. Tank owners are reluctant to spend resources to manage releases of vapors from USTs with secondary vapor recovery, because they can not see how vapors of MTBE escaping a UST can get into ground water.
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision. On-going work on evaluation and validation of passive diffusion samplers, success in showing that vapors released from USTs could contaminate ground water by using deuterated water as a tracer to show that MTBE could dissolve into water vapor condensing from soil gas on the outside of the tank in the winter.
Regional and ORD staff involved: Jack Hwang (R3), Randy Chapman and Alex Wardle (State of VA), Robin Davis and John Menatti (State of UT), Dr. John Wilson, Ken Jewell, Cindy Paul, Cherri Adair, Dr. Dom Digiulio (ORD, NRMRL, GWERD)
What made the Technology Transfer Successful! Application of a novel monitoring technique (stable isotope tracers) and effective presentations at the National Tanks Conference and the Region 3 Tech Workshop.

Title: Technology for In Situ Treatment of Chromium in Ground Water: Macalloy Corporation Superfund site, Charleston, SC
Region: 4
Problem Statement: Disposed solid waste containing significant residual hexavalent Cr(VI) and a large dissolved phase Cr(VI) plume migrating toward a nearby tidal marsh.
Background: Pilot tests for an *in situ* redox zone (curtain) approach were conducted whereby Cr(VI)-impacted groundwater was passively treated upon flowing through the treatment zone. After sufficient data collection demonstrated the prevention of further off-site Cr(VI) migration, the technology was subsequently selected by the potentially responsible party (PRP), Region 4, and the State of South Carolina Department of Health and Environmental Control (DHEC) for full-scale implementation.
Positive Outcome that aided the Region in assessing a problem or assisting a decision: Remediation of the Macalloy site was Superfund's 1000th Construction Completion. A patent has since been obtained for the chemical reductant technology and the potential use of the technology for treatment of other contaminants is currently being explored.
Regional and ORD staff involved: Dr. Ralph Ludwig, Dr. Chunming Su, Frank Beck, Pat Clark, Steve Acree, Randall Ross, Kyle Jones (ORD, NRMRL); Mr. Craig Zeller (Region 4 Remedial Project Manager (RPM))
What made technology transfer successful: Funding provided through Region 4 ($200,000) was critical. The proactive attitude of the RPM was essential; he was willing and eager to entertain new ideas and as a result the project resulted in a "win-win" for Region 4 and ORD.

Title: Monitoring Approaches for Assessing Fate and Transport of Contaminants in Aquatic Systems
Region: 4
Problem Statement: Monitored Natural Recovery (MNR) was selected as the remedy for the Sangamo-Weston/Twelvemile Creek/Lake Hartwell Superfund site. The noninvasive nature and low cost of MNR make it an attractive risk management solution. Annual monitoring of surface sediment concentrations and PCB levels in indigenous fish tissue are conducted in support of the ROD requirements. No definitive evidence existed to show that the ecosystem was recovering.
Background: A NRMRL/NERL Research Team studied the mechanisms responsible for the fate and transport of PCBs in the Lake Hartwell system. NRMRL was responsible for the physical, chemical, and biological characterization of the sediments, water column and air emissions. NRMRL conducted biotic versus Semi-Permeable Membrane Device studies, characterized groundwater and surface water interactions, and developed innovative ways to measure these interactions. NERL was responsible for biological monitoring of the Lake's ecosystem and measuring indicators for recovery.
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision: Research revealed an unknown continuing source of PCBs from Twelvemile Creek to Lake Hartwell. Region 4 was then able to take action to mitigate this source. The work done by the Team at Lake Hartwell is significant in that it resulted in an improved remedy and an array of practical tools for assessing natural fate and transport processes at any site. (See attached table)
Regional and ORD staff involved: Richard Brenner, Paul DePercin, Eric Kleiner, Terry Lyons, Paul McCauley, Marc Mills, and Joseph Schubauer-Berigan (ORD/ NRMRL); James Lazorchak, and David Walters (ORD/ NERL), Craig Zeller (R4)
What made the Technology Transfer Successful: Creation of a multi-disciplinary, cross-organizational, collaborative team and the development of a close working relationship

Innovative tools and techniques developed or refined at Lake Hartwell

Tool or Technique	Mechanism or process
Differential depth, age-dated coring	Physical – Sediment deposition rates
PCB Congener specific interpretations	Biological – Biological and chemical degradation of PCBs (i.e. dechlorination and biodegration
Surface volatilization chambers	Chemical – Evaluate the flux of PCBs from surface water to atmosphere
SedFlume core analysiss	Physical– Evaluate the resistance to scour of deposited sediment
Beryllium isotope profiles	Physical – Evaluate the degree of mixing in the near surface by using natural isotopes of beryllium
SPMDs sediment racks	Chemical – Semipermeable membrane devices (SPMDs) to quantify the partitioning of PCBs from sediment to the water column
SPMDs Chambers	Chemical – Characterize the partitioning of PCBs from sediment
Water column SPMDs	Chemical – SPMDs to quantify the time weighted average surface water concentrations
Deployed bivalves	Biological – Characterize the bioconcentration of PCBs from the water column to deployed Corbicula clams
Deployed Cyprinids	Biological – Characterize the bioconcetration of PCBs from water column to deployed Fathead minnows
Sediment porewater samplers	Chemical – Characterize the porewater concentration of PCBs in-situ
Sediment SPMD samplers	Chemical – Characterize the porewater concentration of PCBs in-situ
In-Well SPMD samplers	Chemical – Characterize the porewater concentration of PCBs in-situ
Sediment Piezometers	Physical – Characterize the advective porewater transport of sediment porewater
Sediment porewater tracers	Physical – Characterize the advective porewater flux using tracers (i.e. Lithium and Stable isotopes)
Stable isotope characterization of the food web	Biological – Characterize the uptake and transport of PCBs in the food web
Invertebrate Uptake	Biological - Using Hester-Dendy's to quantify PCB uptake in indigenous invertebrates
Sediment gas generation	Biological – Characterize the sediment gas production in contaminated and background sediments

Title: Phase 2, Determining the releasability of the asbestos fiber from soils and solid matrices.
Regions: Principal Interest in Regions 5, 8, 9 and 10.
Problem Statement: Empirical data from the EPA Regions and Program Offices have shown specific situations where very low concentrations of asbestos in bulk materials have resulted in unacceptably high releases and resulting airborne concentrations. Findings of high airborne releases have been documented in association with disturbance of asbestos contaminated soils and bulk materials, and indoor dusts.
Background: The ability to predict and model factors that affect the releasability or aerosolization of asbestos and related mineral fibers is needed to manage these exposures to protect public health. Examples of the sources of concern include soils, roads and other structures made from crushed rock, vermiculite attic insulation (VAI), and carpets and other fabrics.
Positive Outcomes: Data from the Testing Device developed for this effort (Releasable Asbestos Field Sampler, RAFS) are being used to: 1) Develop empirical asbestos emission factor and airborne concentration distributions; 2) Develop mass balance models to predict height dependent breathing zone concentrations; and 3) Collect releasability data to compare qualitatively the presence or absence of asbestos by the other methods, e.g., vertical elutriator, EPA Region 10 Glove Box, and activity based sampling (ABS). Three field sites have been sampled to date.
Regional and ORD Staff involved: Keven McDermott, Julie Wroble and Jed Januch (R10); Arnold Den (R9), Paul Peonard, Aubrey Miller, and Mary Goldade (R8). Mark Maddaloni (R2), Glenn M. Shaul and Lauren Drees (ORD/NRMRL/STD)
What Made the Technology Transfer Successful: Teamwork and common objectives.

Title: Evaluation of Ground-Water Impacts from CAFO Facilities
Region: 6
Problem Statement: Develop the means to evaluate the impact of lagoons and spray fields associated with CAFOs on the subsurface and ground water.
Background: This collection of projects/efforts originated from a collaborative effort with the Oklahoma Department of Wildlife Conservation to assess the potential migration of nitrates and CAFO-related compounds via subsurface fate and transport. Region 6 became involved with the effort when it was determined that off-site migration of nitrates was occurring. The initial project has expanded beyond an in-house effort to include RARE-funded projects, including the evaluation of the effectiveness of Comprehensive Nutrient Management Plans (CNMPs).
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision: Positive outcomes include the establishment of RARE projects to address aspects of nutrient management within CAFO spray fields, provided support to the Region office with supporting data for enforcement actions related to ground-water contamination, and has raised the awareness of the potential impacts on ground water and drinking water supplies. The effort is ongoing, with continued communication with Region 6 regarding CAFO-related decisions.
Regional and ORD staff involved: Nancy Dorsey, Carl Wills (R6); Dr. Stephen Hutchins, Mark White, and Dr. Elise Striz (now with the NRC) (ORD, NRMRL, GWERD)
What made the Technology Transfer Successful! Communication and planning

Title: Comparison of the Alternative Asbestos Control Method and the NESHAP Method for Asbestos-Containing Buildings
Regions: Region 6 is the Sponsoring Regional Office, but all Regions could benefit
Problem Statement: Abandoned, dilapidated buildings containing asbestos dot the landscape in communities nationwide. Communities, law enforcement and local government officials spend much time, energy and revenues addressing problems posed by these abandoned structures. Often these properties remain vacant for years and then collapse. During a two-year period, beginning in 2003, more than 166,000 asbestos-contaminated buildings were demolished or renovated nationwide. They were havens for crime, unsafe shelters for the homeless, magnets for children, and potential sources of harmful asbestos.
Background Statement: Region 6 and ORD designed the Alternative Asbestos Control Method (AACM) and initiated a pilot-scale evaluation in a secure location at Fort Chaffee Redevelopment Authority, near Fort Smith, AR. Completed in 2006, it provided a side-by-side testing of the current asbestos removal procedures and the AACM.
Positive Outcomes: The report outlines preliminary findings that support the benefits of asbestos cleanup procedures using the AACM as compared with the existing NESHAP regulatory requirements. The addition of 'amended water' during demolition successfully controlled airborne release of asbestos. Air monitoring data collected from workers also demonstrated lower than expected levels of asbestos and reduced potential exposure to workers.
Regional and ORD Staff Involved: David Eppler and Adele Cardenas (R6), Roger Wilmoth, Lauren Drees and Glenn Shaul (ORD, NRMRL)
What Made the Technology Transfer Successful: ORD helped region with important problem.

Title: In Situ Ground-water Remediation at a Metal smelting Facility Using Permeable Reactive Barriers (PRBs), Asarco East Helena Superfund Site
Region: Region 8
Problem Statement: Develop a site-wide remediation plan to treat ground-water contaminated with high concentrations of arsenic moving offsite to a residential community.
Background: ORD carried out site-specific studies to determine a detailed understanding of the subsurface distribution and migration pathways of arsenic, information necessary for formulating ground-water remediation options. Subsequently, a CRADA was established with the primary responsible party to construct a pilot-scale Permeable Reactive Barrier (PRB) for testing. In addition, ORD has assisted with development of a site-wide plan for ground-water cleanup that includes isolation of the source using impermeable slurry walls, and full-scale PRBs.
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision: Positive outcomes include the establishment of a CRADA, regular involvement of ORD in technical discussions with the Region, completion of the plan for moving forward with the remediation of the highly contaminated aquifer, installation of the first isolation slurry wall in 2006, planning for a larger slurry wall in the fall of 2008, and planning for the installation of full-scale permeable reactive barriers.
Regional and ORD staff involved: Linda Jacobson, Randy Breeden (R8); Dr. Richard Wilkin, Steve Acree, Dr. Douglas Beak, Tony Lee, Dr. Randall Ross, Cindy Paul (ORD, NRMRL, GWERD)
What made the Technology Transfer Successful! Persistence, particularly on the part of regional and ORD scientists and their faith in the effectiveness of the technology.

Title: *In Situ* Biodegradation Technologies for Remediation of Contaminated Sites - An Engineering Issue Paper (EPA/625/R-06/015; NRMRL, 2006)
Region: Cross-Regions, including Engineering Forum, Technical Support Project (TSP) of OSWER's Office of Superfund Remedation and Technology Innovation (OSRTI)
Problem Statement: Effective remediation approaches needed for sites contaminated with halogenated and non-halogenated VOCs, SVOCs, TPHs, BTEX and other similarly toxic compounds impairing soils, groundwaters, surfacewaters, sludges and sediments.
Background: Bioremediation remains an active field of technology research and development at both the laboratory and field level and at 105 Superfund Remedial Actions and 51 Superfund Removal Action projects. Applications to chlorinated aliphatic hydrocarbons, perchlorate and MTBE were developed rapidly in recent years to respond to high priority urgent need and Agency priorities. The potential for the development of innovative bioremediation technologies and applications remains high.
Positive Outcome(s): This Engineering Issue (EI) paper summarizes information on bioremediation technologies and approaches to assist site managers and decision-makers in making informed decisions pertaining to site cleanups.
Regional and ORD Staff Involved: Jon Bornholm (R4), Bernard Schorle (R5), Paul McCauley, Doug Grosse and Dave Riesman, NRMRL.
What Made the Technology Transfer Successful: Direct access to RPMs via the TSP, wide distribution (1500 copies) and the NRMRL technology transfer program (large trade shows and major conferences).

Title: Management and Treatment of Water from Hard-Rock Mines - An Engineering Issue Paper (EPA/625/R-06/014; NRMRL, 2006)
Region: Cross-Regions, including Engineering Forum, Technical Support Project (TSP) of OSWER's Office of Superfund Remedation and Technology Innovation (OSRTI)
Problem Statement: Contaminated water draining from hard rock mine sites continues to be a water quality problem in many parts of the U.S. The types of water range from strongly acidic water laden with metals to variable water quality in mining pit lakes, to alkaline water being released from closed cyanide heap leach operations. These impaired waters adversely impact watersheds, groundwater and surface waters for many years to come unless the source is controlled, eliminated and/or treated.
Background: Acid drainage remains a serious environmental challenge due to its ability to dissolve and move a variety of toxic metals like cadmium, zinc, nickel and mercury into receiving waters. The most common treatment used to date has been neutralization using lime or other suitable alkaline agents followed by oxidation and precipitation of metal hydroxides. Other methods include wetland system approaches and bioreactors (SRBs).
Positive Outcome(s): This engineering information has expanded the knowledge base for reducing risks at mining sites by best defining the scope of mine-related water quality problems to increase the efficiency for site managers, consultants and decision-makers in selecting the most efficient and cost-beneficial managing approaches.
Regional and ORD Staff Involved: Frank Vavra (R3), Brian Caruso (R8), Ed Bates, Dave Riesman, Diana Bless and Doug Grosse, ORD/NRMRL.
What Made the Technology Transfer Successful: Direct access to RPMs via the TSP, wide distribution of documents, and NRMRL technology transfer program (large trade shows and major conferences).

Title: Interactive Abandoned Mine Lands Workshop Series CDROM (EPA/625/C-06/004; NRMRL, 2006)
Region: Cross-Regions, including the National Mining Team, Technical Support Project (OSRTI)
Problem Statement: Abandoned mine land (AML) sites offer some wide-ranging and unique challenges for successful cleanup and restoration of impaired ecosystems due to their remoteness, vastness and contaminant legacies.
Background: Factors such as climate, variability of flow (hydrologic differences), physical differences, site accessibility, political climate, space requirements for limited terrain and wetlands all create problems when implementing innovative technologies at abandoned mines. Differences in sites and within sites require customized treatment methods/remedies.
Positive Outcome(s) that Aided the Region in Assessing a Problem or Assisting a Decision: The workshop has expanded the knowledge base for reducing risks by defining the scope of mine-related water quality problems to increase the efficiency for decision-makers in selecting the most efficient and cost-beneficial managing approaches. Featured technologies have been investigated and recommended by academia, consultants, mining professionals and ORD.
Regional and ORD Staff Involved: Ed Hathaway (R1), Rich Stiemle (OSRTI), Shahid Mahmud (OSRTI), Dave Riesman, Diana Bless, and Doug Grosse, NRMRL.
What Made the Technology Transfer Successful: Workshop interactive multimedia CDROM with wide conference distribution, RPM access, and NRMRL technology transfer program (large trade shows and major conferences).

Title: In-Situ Chemical Oxidation (ISCO)
Regions: 1-5, 7-9
Problem Statement: ISCO is the fastest growing in-situ remediation treatment technology. ISCO has the ability to reduce the contaminant mass flux from source areas to pump and treat systems and/or to reduce cleanup times required.
Background: Scientific investigations are underway to identify site conditions and treatment process variables that contribute to effective and efficient treatment methods.
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision: This collaboration has led to the development of:

(1) scientific methods used in bench- and pilot-scale treatability studies,
(2) design criteria and parameters for bench-, pilot- and field-scale implementation, and
(3) monitoring methods and parameters for more accurate performance evaluation at bench-, pilot-, and full-scale chemical oxidation studies.

An ISCO Engineering Issue Paper has been prepared which presents process fundamentals, design guidelines, operational criteria, and a critical analysis of ISCO (Huling and Pivetz, 2006), (http://www.epa.gov/ada/pubs/issue.html - see, In Situ Chemical Oxidation Engineering Issue).
Regional and ORD staff involved: RPMs listed in the attached Table and Dr. Scott Huling, ORD, NRMRL, GWERD
What made the Technology Transfer Successful: Exchange of information between ORD and Regions; ability to provide technical support based on up-to-date, state-of-the-science knowledge of technological fundamentals and advancements (see attached table)

EPA Superfund Sites involving in-situ chemical oxidation where technical collaboration/suuport has occurred between ORD/NRMRL/GWERD and EPA Project Managers.			
EPA Superfund Sites	**Type of study**	**Contaminant(s)**	**Oxidant(s)**
Region 1, Savage Well, Milford, NH	Pilot-scale study	PCE	$KMnO_4$
SRSNE, Southington, CT	Preliminary feasibility study	chlorinated solvents mixture	Fenton's, $KMnO_4$, $Na_2S_2O_8$, O_3
Olympia, Woburn MA	Pilot- and full-scale	PCE	$KMnO_4$
Region 2 Chemical Leaman Tank Lines, Bridgeport, NJ	Bench-, pilot-, and full-scale	TCE	Fenton's
Fulton Avenue, Manhattan, NY	Bench-, pilot- and full-scale	PCE	$KMnO_4$
Kauffman and Minteer, Springfield, NJ	Bench-, pilot-, and full-scale	TCE	Fenton's
McKenzie, Central Islip, Long Island, N.Y.	Bench-, pilot-scale	1,1,1-TCA, PCE	$Na_2S_2O_8$,
Area 4400 Spill Site, Fort Dix, NJ	Bench-, pilot-, full-scale	PCE, TCE,	Fenton's
Region 3 Standard Chlorine of Delaware, Elkton, MD	Proposed bench-scale study	Chlorinated benzenes	Fenton's, $KMnO_4$, $NaMnO_4$, $Na_2S_2O_8$
Berks Sand Pit, Longswamp Township, PA	Bench-scale study	1,1,1-TCA	Fenton's
Dublin, Dublin, PA	Pilot-scale study	TCE	$KMnO_4$
Maryland Sand, Gravel, Stone, Elkton, MD	Bench-scale study	chlorinated solvents mixture	$KMnO_4$, $Na_2S_2O_8$, Fenton's
Region 4 Parris Island Marine Corp Recruit Depot	Bench- and pilot-scale	PCE, TCE, DCE, VC	Fentons, persulfate
Camp Lejeune, Camp Lejeune, NC	Bench- and pilot-scale study	TCE	Ozone
Southern Solvents, Tampa, FL	Bench- and pilot-scale study	PCE	$KMnO_4$
Hollingsworth, Fort Lauderdale, FL	Bench- and field-scale study	chlorinated solvents mixture	$KMnO_4$, Fenton's, CaO_2
Butler Cleaners site, Jacksonville, FL	Proposed field study	PCE	$KMnO_4$
Brunswick Wood Preserving, Brunswick, GA	Bench-scale study	PAHs	$KMnO_4$, Fenton's
Myrtle Beach AFB, Myrtle Beach, SC	Bench-, pilot-scale studies	TCE	Fenton's
Region 5 Forest Waste Disposa, Otisville, MI	Bench-scale study	chlorinated solvents mixture, BTEX	$KMnO_4$, $Na_2S_2O_8$
Valleycrest Sanitary Landfill, Dayton OH	Bench-scale study	chlorinated solvents mixture	$KMnO_4$
Barrett West Property (Brownsfield Site) Glendale, WI	Bench-scale study	PCE	Fenton's
PPG Contractors Landfill, Barberton OH	Bench-scale study	chloroform	$KMnO_4$, $Na_2S_2O_8$
Region 7 10^{th} street Columbus, Platte County, Nebraska	Pilot-scale	chlorinated solvent mixture	$KMnO_4$
4^{th} and Carey, Hutchinson KS	Bench-, pilot-, full-scale	carbon tetrachloride	Fenton's
Region 8, Lowry AFB, Denver, CO	Field pilot-scale study	TCE	$KMnO_4$, O_3
Region 9, Cooper Drum , South Gate, CA	Bench- and pilot-scale study	chlorinated solvents mixture	$KMnO_4$
Marine Corps Air Station, Yuma, AZ	Pilot-scale study	TCE	O_3
Hunters Point Shipyard, San Francisco, CA	Field pilot-scale study	chlorinated solvents mixture, chlorobenzenes	$KMnO_4$, Fenton's

ETV EXAMPLES

Title: Outdoor Wood-fired Hydronic Heaters Protocol Development and Potential Verifications (Environmental Technology Verification (ETV) Program)
Region: Region 1
Problem Statement: Outdoor wood-fired hydronic heaters (OWHH) are a major source of fine particulate emissions that tend to be highly toxic. Lower emitting technologies need to be developed by industry and their cleaner operation verified.
Background: The ETV Program's Air Pollution Control Technology Verification Center (APCT Center) is supporting the Office of Air Quality Planning & Standards (OAQPS)/industry Voluntary Program to promote the use of newly developed OWHH products that are verified to operate with significantly lowered emissions. The APCT Center is developing a test protocol for evaluating the performance of improved OWHH. Northeast States for Coordinated Air Use Management (NESCAUM) is developing a model rule for regulating OWHH, and some NESCAUM states are developing regulations. The APCT Center is working with NESCAUM and Region 1 to ensure that data sets resulting from APCT Center verifications can support the states' regulatory needs in addition to supporting the Voluntary OWHH program.
Outcomes: OAQPS anticipates that newly developed OWHH technologies attaining the goals of the Voluntary OWHH Program can reduce their fine PM emissions by over 70%.
Regional and ORD Staff Involved: Anne Arnold and David Conroy (R1), Michael Kosusko (ORD/NRMRL/APPCD), Gil Wood (OAQPS), Lisa Rector (NESCAUM)
What will make technology transfer effective? Close coordination with the program office (OAQPS), industry and the NESCAUM states; credible performance data easily available on the EPA web for regulators and decision-makers purchasing these technologies.

Title: Lead in dust monitors and lead in paint test kits
Region: 1
Problem Statement: Lead-based paints were banned in residential applications in 1978 due to its toxic effects, particularly to women and children. Renovation, repair, and painting (RRP) may disturb painted surfaces and produce a lead exposure hazard, so the accurate and efficient identification of lead-based paint in housing is important. Approximately 24 million US dwellings are at risk for lead-based paint hazards.
Background: Lead-based paint test kits are available to help homeowners and contractors identify lead-based paint hazards before any remediation activities take place so that proper health and safety measures can be enacted. OPPT has contributed co-funding to the AMS Center to support development of a verification protocol for evaluating the performance of lead-based paint test kits.
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision. EPA developed a proposed rule requiring an EPA evaluation and recognition program for test kits to be used during RRP. EPA will only recognize those kits that have been tested through this process. A verification protocol to evaluate lead-based paint test kits is being developed by the AMS Center. Upon completion, vendors will be recruited for a verification test.
Regional and ORD staff involved: Maggie Theroux (R1), Environmental Technology Council Action Team on Lead Paint Remediation in Dwellings, OPPT, and ETV Advanced Monitoring Systems Center.
What made the Technology Transfer Successful: The technical panel of critical stakeholders (including EPA/OPPT, EPA/NERL, HUD, CDC/NIOSH).

Title: ELISA kits for Endocrine Disrupting Compounds (ETV Technology Project)
Region: 3 (Region 5 is also involved but RARE support is from Region 3)
Problem Statement: Available analytical methods for EDCs are beyond the capabilities of many regional and state laboratories. ELISA test kits may present a more economical, less resource intensive method to address EDC contamination in environmental waters.
Background: The Advanced Monitoring Systems (AMS) Center is planning a verification test of enzyme-linked immunosorbent assay (ELISA) test kits for the quantitative determination of endocrine disrupting compounds (EDCs) in aqueous samples. The EDCs that will be evaluated include estrogenic hormones and alkyl phenols. The test is a collaboration between the AMS Center and several EPA laboratories including Region 3, Region 5, ORD/NRMRL, and ORD/NERL. The AMS Center received RARE funds to support the test. Vendor recruitment has begun, and the test/QA plan has been drafted. Testing will be conducted in the coming months.
Positive Outcome(s) that aided the Region in assessing a problem or assisting a decision. The Regional and ORD laboratories will obtain valuable practical, hands-on experience with using ELISA test kits. Publication of the performance testing results will assist all Regions in their assessment of this issue.
Regional and ORD staff involved: Ron Landy (R3), Dennis Wesolowski (R5), Eric Kleiner, Marc Mills (ORD, NRMRL, LRPCD), Jim Lazorchak, Dan Bender, Jeanette Van Emon (ORD, NERL) and ETV Advanced Monitoring Systems Center.
What made the Technology Transfer Successful: Interagency cooperation that provides a variety of "typical" end users, valuable in the assessment; experience gained by test participants.

Title: Verification of Diesel Retrofit Technologies to Support Regional Implementation of Diesel Retrofit Grant Programs (Environmental Technology Verification (ETV) Program)
Regions: All
Problem Statement: Legacy heavy-duty diesel engines are significant sources of NOx and fine particulate emissions. These sources are major contributions to pollution in areas that are in non-compliance with air quality standards.
Background: Grant programs at the EPA Regional, state, and local levels provide funding to retrofit existing diesel engines and fleets to reduce emissions. The National Clean Diesel Campaign (NCDC), managed by the Office of Transportation and Air Quality (OTAQ), list effective retrofit technologies eligible for use in these grant programs. The Air Pollution Control Technology Center (APCT) Center develops verification data that vendors can use to apply to NCDC for listing.
Outcomes: Eleven technologies have been verified by the APCT Center and ten added to the NCDC list. A case study developed by the ETV Program in 2006 estimates a potential reduction of 6.4 to 9.1 tons of PM over seven years, resulting in 0.49 to 0.70 avoided cases of premature mortality, with an economic value of $3.2 to $4.5 million. Recent and ongoing verifications are focused on NOx reduction technologies.
Regional & ORD Staff involved: Sandra Rennie (R6), Rudy Smalling, (Houston Advanced Research Center, NOx reduction technology development grants), Michael Kosusko (ORD/NRMRL/APPCD), Dennis Johnson, Jim Blubaugh (OTAQ)
What makes technology transfer effective? Close coordination with the regions and with the program office; regularly scheduled telephone communication; credible objective performance data for making good regulatory, planning and purchasing decisions; readily available information on the EPA web site.